

**ANALYSIS OF THE AUTHORS' RIGHTS COLLECTION FRONTIER
USING PCA-MDEA: AN APPLICATION TO THE VALENCIA REGION**

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Abstract

The aim of this paper is to estimate the authors' rights collection frontier within the collection zones into which the Valencia Region (Spain) has been divided. To be more exact, a nonparametric frontier technique (Modified Data Envelopment Analysis, MDEA) and the Principal Components Analysis (PCA) are jointly employed to map out an initial approach to the potential authors' rights collection within this region (as divided into collection zones). The analysis has been carried out both jointly and by majority sectors (performing, musical, and audio-visual arts).

Keywords: authors' rights collection, MDEA, PCA.

1. Introduction

If we accept the “advent” of the Information Society, of the “New Economy”, or other similar terms, it is quite clear that the concept of “intellectual property” is going to become a recurrent subject within the sphere of Social Sciences. What we are really talking about is a redefinition of the term “property right” as applied to intangible production, the term that defines and composes, or will compose, the majority of the interchanges that will take place in this “New Economy”.

The Societies that manage these intellectual property rights are confronted with a dilemma, which is not trivial at all in nature, when attempting to maximise their income; one is either capable of increasing collection by extending the definition of the elements subject to authors' rights (the conflicts produced in Spain towards the end of the 90's in relation to the collection of rights generated by televisions in hotel rooms could serve as an anecdotal example of this first strategy), or one tries to improve the efficiency of the collection procedures. In order to approach this second strategy it is vitally important to be aware of the extent of a viable collection, or the loss of collection percentage due to technical reasons.

These reflections lead us to ask ourselves whether the current collection of authors' rights is efficient. Is the collection effective in relation to its potential?. Are the collectors situated on the frontier?. In other words, collection could be increased by simply improving the efficiency of the collection process, allowing inefficient units to catch up the collection frontier.

The aim of this paper is to propose an analytical model capable of responding to the previous questions. To do this we will use the collection data of a Spanish region: the Valencia Region.

Within this context, the work has been articulated as follows: In the first section, the subject of the authors' rights, its legitimacy and the collection system is introduced. In the following section, a brief methodological discussion is held on the methods employed for estimating the frontiers. A description is given of the method chosen for our study. In section 3 we set out the model and comment on the results obtained. Finally, in the last section, we set forth our final comments and we propose possible extensions.

2. Authors' Rights

The basic economic reason behind the protection of authors' rights lies in the fact that without this protection the fixed costs and the efforts involved in creating artistic works cannot be recovered if counterfeiters and imitators are allowed to act as *free-riders* at the expense of the author's creativity. The suitability of authors' rights provides the necessary incentives for creative works to be supplied in quantities that the market can bear. Without Copyright, the market would contain a smaller number of creative works than those permitted by the available resources. Another necessary and natural supposition, from the point of view of the Economy (but controversial from a supposedly strictly cultural perspective), is that direct financial rewards are an excellent incentive for the creative process (although there exist other motivating factors which must be considered, which may be exclusively intrinsic, such as the joy of the creation, or such as fame, recognition and reputation). The higher prices resulting from this temporary monopoly are more than compensated for given that the additional benefits enjoyed by society as a whole exceed the

higher costs paid by the consumer. In any case, it is necessary to understand that we are dealing with a marginal analysis in which the important factor is the amount of works created, with no mention being made of the type of goods produced. Naturally, this protection process also implies a series of transaction costs: legislation, cost of contracts, legal processes undertaken against offenders, etc.

Legislation and institutions based on these principles and which protect, represent and manage authors' rights exist in all Western countries. In the Spanish case, the Royal Legislative Decree 1/1996 (12th of April) (by which the revised text on the Intellectual Property Act was approved, thus regulating, clarifying and harmonizing the effective legal dispositions relative the matter) constitutes the corner stone of Spanish regulation on intellectual property. The collective Agencies that manage intellectual property rights can define themselves as associative, not-for-profit organizations dedicated in their own name or on behalf of others to the management of intellectual property rights on behalf of the legitimate owners.

The *Sociedad General de Autores y Editores* (SGAE) is an Association of Creative Artists founded to protect and manage the intellectual property rights of authors and publishers. It is the first authors' rights management organization in Spain (although it is not the only one; currently there are eight recognised agencies in Spain: *Sociedad General de Autores y Editores* (SGAE); *Centro Español de Derechos Reprográficos* (CEDRO); *Asociación de Gestión de Derechos Intelectuales* (AGEDI); *Artistas Intérpretes o Ejecutantes, Sociedad de Gestión de España* (AIE); *Visual, Entidad de Gestión de Artistas Plásticos* (VEGAP); *Entidad de Gestión de Derechos de los Productores Audiovisuales* (EGEDA); *Artistas Intérpretes, Sociedad de Gestión* (AISGE); *Asociación Derechos de Autor de Medios Audiovisuales* (DAMA)) and the fifth in the World. It occupies the seventh place among the Societies with greater collection capacity and has the fourth lowest management costs. It defends and represents the authors' rights of composers, lyricists, publishers, scriptwriters, directors, dramatists, choreographers and sketch writers, among others. It manages a total of three million theatre, audio-visual, choreographic, pantomime, musical comedy, dramatic-musical comedy, ballet, cinematographic, documentary film and docudrama works. It brings together more than 500 publishers and distributed 31430 million pesetas (189 million Euros) during 1998.

In general, the authors societies collect levies for the different activities subject to authors' rights. For the aims of this work, we have centred on the SGAE collection model. According to the terminology employed by the SGAE, the collection categories are: "Dramatic", a concept that corresponds to the collection for theatre plays, "Varieties", that would correspond, approximately, to the performances of musical vocal groups; the term "Human Performance", corresponding to live instrumental performances (jazz, chamber groups, blues, etc.), "Mechanical Performance", which corresponds to the reproduction of recorded music (discos, leisure locations in which recorded music is programmed, etc.) and "Symphonic", which corresponds to the performances of orchestras and bands. Thus, the first five epigraphs deal with musical and theatrical activities. In following epigraph we find the rights generated by the tax payable for the existence of television receivers and video reproducers in public spaces. "Cinema" corresponds to the rights protected in cinematographic exhibitions and, finally, "Radio and Television Diffusion" corresponds to the amounts collected from radio and television diffusion. In the last epigraph we have grouped together "Other" concepts of collection for lesser amounts.

Table 1 – Distribution of Authors' Rights Collection by Concept in the Valencia Region (1998).

Collection Concept	%
Dramatic	10,28
Varieties	10,42
Human Performance	7,90
Mechanical Performance	32,98
Symphonic	1,47
Television and Video	17,68
Cinema	14,54
Radio and TV Diffusion	3,16
Others	1,57

Source: SGAE (Valencia Regional Office) and authors.

As a whole, we can observe that the main source of collection corresponds to mechanical performance, followed by the levies applied to television sets and videos, the rights generated by cinematographic exhibition and, finally, live vocal music and theatre performances, which account for almost 90% of the total collection. Each of the named epigraphs represents at least the 10% of the overall.

The authors' rights collection is effected through commission agents, each of which is responsible for one of the 17 zones into which SGAE-Valencia (regional branch) divides the territory of the Valencia Region, each one composed by various municipalities. Valencia city is split in two different zones by SGAE (downtown and outskirts), which have been joined for analytical purposes (there is no split data for the inputs to such disaggregated level).

It is necessary to point out two important details in order to adequately situate the importance of the sums collected in the Valencia Region zones; firstly, this data does not reflect all theatrical, audio-visual and musical cultural activities, given that not all of these activities are subject to author' rights. On the other hand, although the SGAE control and collection network has been greatly modernized in recent years, increasing considerably its collecting capacity, not all of the activities subject to rights are fully controlled. It is precisely in this report where we have tried to determine the efficiency of the collection system, using a series of techniques which are explained below.

3. Frontier Analysis: a brief methodological discussion

The branch dedicated to analyse the so-called frontiers of production, of potential production, or efficiency frontiers is a result of an obsession produced by our limited capacities as economic agents.

This type of analysis is centred on the existing differences between real and potential production. Thus, we are talking about technical efficiency. Nevertheless, in practical terms, we have no more than data, which is why an empirical frontier must be established; to this end, reference has been made to the best agents (the most technically efficient, those situated on the "frontier"). On the other hand, this method has shown itself to be superior to others

(e.g. ratio analysis, cost- benefits analysis, etc.); reference may be made to the working document produced by Bauer *et al.* (1997), in which it is stated that “the main advantage of frontier efficiency over other performance indicators is that it is an objectively determined quantitative measure that removes the effects of market prices and other exogenous factors that influence observed performance”.

Frontier analysis is divided into two great areas, or techniques, of estimation: those of parametric and those of nonparametric frontiers. The differences between these two techniques are related to the shape of the frontier itself, the existence of a disturbance term and, when applicable, its random distribution and that one of the inefficiency term.

The DEA nonparametric technique of mathematical programming (based on the Farrell concept of efficiency, 1957) will be employed in our work. We take advantage of the technique’s positive aspects, among which we can find not having to explicitly specify a production function, its capacity to handle multiple inputs and outputs and, as indicated by Seiford & Thrall (1990), its capacity for “uncovering relationships that remain hidden for other methodologies”.

Basic DEA models would allow us to identify and separate efficient units from inefficient ones while simultaneously indicating a benchmark (potential collection, in our case) for this last category. If we use the modification proposed by Andersen & Petersen (Modified Data Envelopment Analysis (MDEA), 1993), we will additionally be able to establish categories within the efficient units themselves, constituting a more precise collection frontier (*efficiency surface versus projection surface or new efficiency surface*, following the terminology of Xue & Harker (1999)).

4. The Authors’ Rights Collection Frontier

As we have already mentioned, one of the advantages of the DEA technique is not having to determine an explicit definition of the production function. Thus, DEA does not go deeply into the transformation of inputs into outputs, constituting itself as a “black box” model and focusing on the problem of specification in the selection of inputs and outputs. Moreover, parametric techniques tend to confound functional form misspecification with inefficiency.

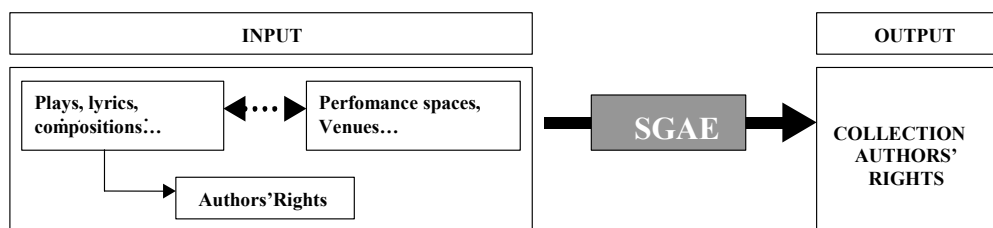


Figure 1 – The Production Function of Authors’ Rights.
Source: Authors.

The production function represented in Figure 1 is in fact more complex than it is shown in this article. We can define a production function in accordance with two stages; the first one is implicit to our analysis: the process that generates author’ rights from artists’ works and

songs or scriptwriters' cinematographic stories. This first transformation would be represented by the continuous line within the input box in the Figure 1. Given the complexity of this phase of transformation it is easier to give a theoretical demonstration (see, for example, Koboldt, 1995; Rushton, 1998; or Towse, 1999) than to give an empirical demonstration. This transformation process is the corpus that partly supports and legitimises the second level of the transformation process: the securing of a collection for authors' rights (the outputs of our analysis) from such ethereal resources as author' rights (materialized by means of the use of measurable variables: our inputs).

a) The model

By considering the collecting body as a transformer which has the generators of authors' rights and, therefore, of the collection (output) as its resources, we can establish a frontier of collection possibilities in which the different units of analysis are the different municipalities within the collection zones. These municipalities represent the actual DMUs: the SGAE agents that collect the levies.

From a basic DEA model, Andersen & Petersen (1993) proposed a simple modification to the programme; the central idea of this MDEA (Modified DEA) is the exclusion of the evaluated unit of the reference group, so it allows the comparison of both inefficient and efficient units.

The model we use is an output-oriented MDEA (it considers a maximization of outputs in accordance with the inputs), since we want to check the potential collection, with variable returns to scale (BCC model), and in accordance with the Andersen & Petersen (1993) modification. It may be pointed out, nevertheless, that in spite of Andersen & Petersen (1993) explaining that their method is applicable under variable returns to scale, Xue & Harker (1999) affirm that possible infeasibility problems may exist.

Analytically, the model is as in (1), adapted from Andersen & Petersen (1993).

$$\begin{aligned}
 & \text{Max}_{\phi_j, \lambda, s^+, s^-} \phi_j + \varepsilon \bar{\mathbf{1}}^T s^+ + \varepsilon \bar{\mathbf{1}}^T s^- \\
 & \text{s.a.: } \phi_j Y_j - \sum_{\substack{k=1 \\ k \neq j}}^n \lambda_k Y_k + s^+ = 0 \\
 & \sum_{\substack{k=1 \\ k \neq j}}^n \lambda_k X_k + s^- = X_j \\
 & \sum_{\substack{k=1 \\ k \neq j}}^n \lambda_k = 1 \\
 & \lambda, s^+, s^- \geq 0
 \end{aligned} \tag{1}$$

where \mathbf{Y} and \mathbf{X} are the output ($s \times n$) and input ($r \times n$) matrices respectively, n being the number of decision units; ϕ_j is the efficiency *score* of the evaluated unit, ε is an infinitesimal constant term and $\mathbf{1}$ is a unitary vector; λ is the vector of coefficients that conform the linear combination to which the DMU in evaluation is compared (reference group), and s^+ and s^- are the slacks.

This model allows the different inefficient, efficient, or super-efficient units to be characterised. If the *score* obtained is equal to the unit, it is considered as efficient, whereas a score greater than that of the unit implies inefficiency (the excess with respect to the unit is the percentage by which the output has to be increased in order to obtain an efficient level). However, if the *score* is less than the unit it is considered as super-efficient (in this case, the difference with respect to the unit specifies by which percentage the output could be reduced whilst maintaining efficiency).

Outputs

We can easily extract our ideal outputs from the first section; grouping by affinity we obtain three groupings: collection in “Performing” (Dramatic), “Musical” (considered as Varieties, Human Performance and Symphonic, plus Mechanical Performance), and “Audio-visual” (Television and Video, plus Cinema and Radio and TV Broadcasting), concepts that cover 98.43% of the collection (10.28%, 52.77% and 35.38%, respectively). All is measured in Spanish pesetas (ESP).

Inputs

The generation of authors' rights is strongly linked to both cultural production and culture consumption; that is, supply and demand of culture. So then, what factors will affect the collected amount?. Those factors with a noticeable structural character that determine the supply and demand possibilities by preventing or allowing certain events, and those that mark the combined conditions, with a certain incidence in the cultural production-consumption process.

Basing ourselves on the selection of outputs and these brief initial considerations, for choosing the inputs we must restrict our search to those with a clear relation and incorporation to the production-consumption process of the chosen cultural concepts (performing arts, musical arts, and audio-visual arts); on the other hand, we can base ourselves on preview studies in which the validity of the election of our inputs has been demonstrated (see Rausell *et al.*, 1999; and Carrasco, 1999). In this way, our inputs would be: “stage sites” (according to SGAE (1999), “group of spaces of all types, venues, function rooms, theatres, plots, public thoroughfares, etc., in which stage performances are carried out”), “theatrical performances”, the “people attending these representations”, “music venues” (classical and modern music – once again, according to SGAE (1999), musical venues are defined as the “group of spaces, venues, concert halls, stadiums, theatres, bull-rings, sports centres, plots, public thoroughfares, etc., in which this type of show is performed”), “concerts and sessions” (performed in the music venues), “spectators” (of these concerts), number of “musical societies” (“The phenomenon of musical societies is without doubt the most important differential cultural fact within the Valencia Region [...]. Nevertheless, the phenomenon of the Musical Societies has a contradictory effect upon the articulation of the Local Cultural Systems, given that in other works (Carrasco, 1999) we have been able to prove that the penetration of the music bands within determined municipals may have a displacement effect on other activities” (Rausell *et al.*, 1999; translation from Catalan).), number of “cinema screens”, “cinema capacity” (number of seats), “cinema spectators”, number of “restaurant industry sites”, number of “local television stations”, and “square meters of retail outlets”.

Moreover, there is no doubt that the phenomenon of cultural activities is highly intensive in terms of training and income (Rausell *et al.*, 2002; SGAE, 2000). In fact, historically, “the cultural consumption has been patrimony of an educated elite with great economic

resources” (Rausell, 1999). It is for that reason that we include two additional inputs to account for this likely cultural demand endowment: an indicator of “human capital” and “available household income”.

Table 2 – Outputs and Inputs employed.

Description	Variable	Average	Std. Error
OUTPUTS			
Collection from Performing Arts	RESC	657.833	4M
Collection from Music (live plus reproduced)	RMUS	3.414.845	12M
Collection from Audiovisual	RAUD	2.285.224	9M
INPUTS			
Stage Venues	RECESC	4,05	5,18
Theatrical and Dance Performances	REPESC	20,55	43,90
Spectators (performing arts)	ESPESC	7.967,86	46.483,97
Music Venues	RECMUS	7,20	11,12
Concerts and Sessions	REPMUS	8,67	12,51
Spectators (music)	ESPMUS	14.580,63	73.849,77
Music Associations	SM	1,55	2,39
Cinema Screens	CINES	2,51	6,55
Capacity (cinema)	BUTACAS	1.022,39	2.491,31
Spectators (cinema)	ESPCINE	82,652,83	477.643,35
Local Television Stations	TVL	0,65	0,86
Restaurant Industry Sites	RESTBAR	182,02	441,06
Square Metres of Retail Shops	M2COMMIN	59,617,23	144.419,02
Human Capital	CAPHUM	0,10	0,05
Available Household Income	RFD	1.318.863	338.201

In order to boost the discriminative capacity of the analysis we will carry out a pre-Principal Component Analysis (PCA) of the inputs so as to reduce the dimension of the matrix X. We must bear in mind that the greater the number of inputs plus outputs (r+s), the greater the number of units (considered) as efficient. Neither must we forget that negative correlation is one of the properties of synthetic inputs (components obtained in the PCA), thus avoiding the effects of interaction in our analysis.

Nevertheless, given the structure of PCA, some Principal Components may have negative values. This fact can affect DEA analysis; however, the BCC output-oriented model is invariant before affine transformations in the inputs (Ali & Seiford, 1990; Pastor, 1996) allowing us to transform the inputs in such a way that they take strictly positive values. The transformation is, in the basics, that proposed by Adler & Golany (2000); it is showed in equation (2):

$$X_{PCi} = X_{PCi} + b \quad b = \text{abs}(\text{Min} \{X_{PC}\}) + 1 \quad (2)$$

An initial joint analysis considering all of the inputs and the three outputs (collection from performing arts, from music and from audio-visual) will be made. Then, it will be repeated with the same outputs and the synthetic inputs obtained from the PCA in order to check if there are changes in the number and structure of the efficiency scores due to the reduction of variables in the analysis.

The most representative sectors (performing arts, musical arts, and audio-visual arts), relating to different collection concepts, will later be analysed separately. This analysis will help us to assess the efficiency in these different sources of authors' rights, in order to advice where to put the efforts for improving the collection system.

b) The Data

The data referring to the collection of author' rights (outputs) has been provided by the SGAE-Valencia delegation; it corresponds to the effective collection resulting from the 1998 fiscal year in the collection zones situated within the Valencia Region. The Rausell *et al.* (1999) municipal estimation has been employed for the elaboration of the municipal data.

With regard to the inputs, the data relative to stage and musical venues and representations has been provided by "Agenda SGAE", facilitated by the SGAE-Valencia delegation; the cinema screens and capacities data comes from the delegation's own cinema census; the number of spectators (stage, musical and cinema) is based on the regional spectator and percentage data, in turn based on the number of inhabitants per municipality, extracted from the *Anuario SGAE de las Artes Escénicas, Musicales y Audiovisuales* (SGAE, 1999) (Performing, Musical and Audio-visual Arts Yearbook (SGAE, 1999)). The number of restaurant industry sites and square metres of retail commerce has been extracted from the *Anuario Comercial de España, 1999* (Spanish Commercial Yearbook, 1999), produced by the Studies Service of "la Caixa" (Catalonian Savings Bank). The number of musical societies is taken from the *Federación de Sociedades Musicales de la Comunidad Valenciana* (FSMCV) census, whereas the number of local television transmitters comes from the AIMC census (April 1999).

The proxy employed for the human capital is the percentage of the active population with university or college degrees, calculated from the INE (National Institute of Statistics) Population Census (1991) data. The available household income (per capita) is based on the estimation made at municipal level by Bachero *et al.* (1997) for 1995. The analysis will be made using all of the municipalities with over 5000 inhabitants located in specific collection zones within the Valencia Region (132 municipalities, almost 25% of the total, which account for more than 86% of the population (according to INE data) and practically all of the municipal collection authors' rights (93.61%)).

c) The Results

Having carried out the PCA on the input variables, we obtain the synthetic inputs. The Kaiser-Meyer-Olkin (KMO) sample adjustment test and the Barlett test for sphericity proved satisfactory in all the models.

Five different models have been considered: "All Sectors" (basic and reduced), "Performing Arts Sector", "Music Sector" and "Audio-visual Sector"; for each one a different aggregation has been made, including different primary inputs. In Table 3 we can observe the factorial matrices and the variables from which we have formed our synthetic input variables.

Table 3 – Factorial Matrices. KMO and Barlett Tests, and % of Information Accumulated by Components*,.**

Variables	All Sectors (red.)			Performing Arts		Musical		Audio-visual	
	PC11	PC21	PC31	PC12	PC22	PC13	PC23	PC14	PC24
RECESC	0,860	≈ 0,000	0,239	0,868	≈ 0,000				
REPESC	0,948	≈ 0,000	0,119	0,949	≈ 0,000				
ESPESC	0,952	-0,158	-0,218	0,958	-0,130				
RECMUS	0,866	0,112	0,304			0,891	≈ 0,000		
REPMUS	0,855	0,128	0,316			0,881	≈ 0,000		
ESPMUS	0,958	-0,153	-0,200			0,951	-0,160		
SM	0,855	-0,224	-0,331	0,886	-0,176	0,852	-0,213	0,877	-0,178
CINES	0,938	≈ 0,000	≈ 0,000					0,963	≈ 0,000
BUTACAS	0,930	≈ 0,000	≈ 0,000					0,961	≈ 0,000
ESPCINE	0,958	-0,153	-0,200					0,955	-0,133
TVL	0,474	≈ 0,000	0,638					0,500	≈ 0,000
M2COMMUN	0,990	≈ 0,000	≈ 0,000	0,987	≈ 0,000	0,979	≈ 0,000	0,984	≈ 0,000
RESTBAR	0,980	≈ 0,000	≈ 0,000	0,974	≈ 0,000	0,972	≈ 0,000	0,979	≈ 0,000
CAPHUM	0,319	0,713	-0,330	0,341	0,752	0,353	0,737	0,354	0,752
RFD	0,180	0,837	≈ 0,000	0,199	0,842	0,215	0,837	0,201	0,838
KMO	0,883			0,829		0,796		0,853	
Barlett Sig.	0,000			0,000		0,000		0,000	
% Ac.	70,93	9,17	6,88	67,94	16,63	65,96	16,60	65,28	14,77
	86,98			84,57		82,56		80,05	

* PCij ≡ Principal Component i of Model j.

** Blank spaces indicate that the variable has not been included in the model.

From the PCA we can extract, though not forming part of the explicit aims of our analysis, the rationale of the variable grouping. In this way, though rather superficially, the first component of each of the models could be summarised as “INPUTS-CULTURAL SUPPLY”, whilst in the second we are dealing with “INPUTS-CULTURAL DEMAND”. It must be pointed out that in the first model TVL remains outside the first component and comprises the third component (“INPUTS-LOCAL TELEVISION”).

In order to calculate the levels of efficiency we employed the software known as EMS (Efficiency Measurement System) developed by Holger Scheel (University of Dortmund) which is freely available for academic use.

The results according to geographic areas are shown in Tables 4 to 8. The information presented reflects the number of municipalities per area which are efficient (score less or equal to the unit), the district percentage to which it corresponds, and the scores average, as well as the corresponding Pearson’s variation coefficient (it will enable us to compare the homogeneity of the districts with respect to the relative efficiency of the municipalities that make up the sample).

Table 4 – Model: “All Sectors (basic)”.

Inputs: all those considered in section 3.1.
Outputs: RESC, RMUS, RAUD.

Collection Zone	Efficient Municipalities		Score	
	Nr	%	Average	VC ^a
Alicante Capital	1	100,00	0,3351	0,00
Alcoy	2	66,67	0,8543	47,80
Denia	4	57,14	0,7811	66,16
Elche	7	87,50	0,7757	53,44
Monovar	12	92,31	0,4511	96,40
Torrevieja	7	58,33	1,2297	118,75
Benidorm	1	100,00	0,1038	0,00
Castellón Capital	1	33,33	1,0777	61,45
Vall d'Uxó	2	22,22	1,5057	49,76
Vinaroz	0	0,00	1,4706	14,76
Valencia Capital	1	100,00	0,4334	0,00
Cárcer	4	25,00	1,3481	65,93
Catarroja	13	72,22	0,8149	45,87
Gandía	1	20,00	1,6681	46,38
Puzol	12	60,00	1,0111	77,52
Requena	5	83,33	0,8423	19,35
Σ	73 ^b	58,40	1,0025 ^c	81,51

^aVariation Coefficient (%). ^bTotal. ^cArithmetic. Avg.

Table 5 – Model: “All Sectors (reduced)”.

Inputs: PC11, PC21, PC31.
Outputs: RESC, RMUS, RAUD.

Collection Zone	Efficient Municipalities		Score	
	Nr	%	Average	VC ^a
Alicante Capital	0	0,00	1,6520	0,00
Alcoy	1	33,33	1,4034	70,99
Denia	0	0,00	6,7405	57,33
Elche	0	0,00	2,3713	35,11
Monovar	3	23,08	2,3050	68,81
Torrevieja	0	0,00	8,8099	39,33
Benidorm	1	100,00	0,2477	0,00
Castellón Capital	0	0,00	3,8138	49,21
Vall d'Uxó	0	0,00	6,7640	38,40
Vinaroz	0	0,00	4,5777	8,56
Valencia Capital	1	100,00	0,0000	0,00
Cárcer	2	12,50	4,9403	49,53
Catarroja	1	5,56	3,0615	66,94
Gandía	0	0,00	4,9216	35,54
Puzol	3	15,00	3,4313	54,63
Requena	1	16,67	3,4639	63,10
Σ	13 ^b	10,40	4,3007 ^c	71,81

^aVariation Coefficient. ^bTotal. ^cArithmetic Avg.

Finally, in Table 9 the collection zones are sorted according to efficiency scores and the number of efficient municipalities; i.e. the number of municipalities within a zone that can be said to be positioned at the collection frontier. So, for example, a district with a 5 in the “Sco” column would be the 5th in the list according to its efficiency score average. Following the same reasoning, a district which has the higher efficient cities percentage would have a number 1.

From the basic model (results shown in Table 4) we can see that 58,40% of municipalities are efficient, this is, the authors' rights collection frontier is made up of 77 cities. However, we see that only 9 of the 16 zones are efficient. Anyway, on average, the whole region shows a value close to 1 (express efficiency), although we have to consider a variation of more than 80% (the variation coefficient for the whole sample is 0,8151). If we look at the individual variation coefficients we can see that the degree of efficiency of the municipalities within each zone reflects a rather homogenous pattern.

In more than half of the zones almost 60% of the municipalities are considered to be efficient. This fact may seem to be plausible, nevertheless Charnes *et al.* (1994) pointed out that the choice of inputs (and outputs) is crucial for the analysis and, furthermore, the discriminatory power of the technique tends to be reduced as the number of dimensions (number of inputs+outputs) is increased.

Then, we proceeded to reduce the number of inputs, so only three aggregate inputs were considered in the general model (Cultural Supply, Cultural Demand and Local Television). There was a dramatic polarisation of the sample and we found that 2 areas were particularly efficient (Valencia and Benidorm, each of which comprise a sole municipality); the rest of the areas were too inefficient (with the exception of Alicante, with a moderate score of 1.65 and Alcoy giving a score of 1.40).

It must be said that the zone evaluation may overlook one aspect considered in this new analysis: the zones appear to be less heterogeneous (reduced variation coefficients; in the total sample it is close to 72%, compared with 81,51% in the previous sample) and the number of efficient units drastically diminishes to 13. Nonetheless, even though the scores of the first model make more economic sense, (the elevated scores of the extended models would imply having to increase on average collection by 4 times), the second model gives us a diminished frontier which will provide us an enhanced discrimination between the municipalities.

On the other hand, if we consider the zones sorting (ranking of efficiency shown in Table 9) for both models (basic and reduced), the Spearman test and Kendall's Tau-b indicate that both rankings (that one based on the scores and that one based on % of efficient municipalities) present correlation with a significance level of 5%.

Given the results generated (better discrimination and close efficiency rankings) we undertook sector analysis with the combined use of PCA-MDEA (results shown in Tables 6 to 8).

Table 6 – Model: “Performing Arts Sector”.

Inputs: PC12, PC22.
Outputs: RESC.

Collection Zone	Efficient Municipalities		Score	
	Nr	%	Average	VC ^a
Alicante Capital	0	0,00	1,5550	0,00
Alcoy	0	0,00	15,2827	31,17
Denia	0	0,00	25,8506	46,31
Elche	0	0,00	5,1834	37,69
Monovar	3	23,08	3,6337	60,12
Torreveija	1	8,33	25,9425	61,25
Benidorm	0	0,00	13,2448	0,00
Castellón Capital	0	0,00	5,4620	35,83
Vall d'Uxó	0	0,00	13,5176	25,64
Vinaroz	0	0,00	16,5804	6,67
Valencia Capital	1	100,00	0,0498	0,00
Cárcer	0	0,00	8,7706	30,66
Catarroja	0	0,00	6,3801	41,70
Gandía	0	0,00	13,1045	37,48
Puzol	0	0,00	8,4845	38,01
Requena	0	0,00	7,4546	34,78
Σ	5 ^b	4,00	10,7839 ^c	88,13

^aVariation Coefficient. ^bTotal. ^cArithmetic Avg.

Table 7 – Model: “Musical Sector”.

Inputs: PC13, PC23.
Outputs: RMUS.

Collection Zone	Efficient Municipalities		Score	
	Nr	%	Average	VC ^a
Alicante Capital	0	0,00	2,2742	0,00
Alcoy	0	0,00	9,3212	36,26
Denia	0	0,00	14,9664	57,89
Elche	0	0,00	7,4277	37,63
Monovar	2	15,38	8,0284	69,21
Torreveija	1	8,33	10,1563	66,99
Benidorm	1	100,00	0,2778	0,00
Castellón Capital	0	0,00	6,2719	48,21
Vall d'Uxó	0	0,00	19,0775	46,34
Vinaroz	0	0,00	6,2372	3,39
Valencia Capital	1	100,00	0,0797	0,00
Cárcer	0	0,00	14,6659	47,04
Catarroja	0	0,00	10,0842	40,60
Gandía	0	0,00	14,7269	47,17
Puzol	1	5,00	6,7128	46,25
Requena	0	0,00	16,6730	44,87
Σ	6 ^b	4,80	10,7849 ^c	66,10

^aVariation Coefficient. ^bTotal. ^cArithmetic Avg.

Table 8 – Model: “Audio-visual Sector”.

Inputs: PC14, PC24.
Outputs: RAUD.

Collection Zone	Efficient Municipalities		Score	
	Nr	%	Average	VC ^a
Alicante Capital	0	0,00	2,1722	0,00
Alcoy	0	0,00	4,6229	29,89
Denia	0	0,00	7,6732	46,48
Elche	0	0,00	3,0279	76,03
Monovar	2	15,38	2,5901	66,04
Torreveija	0	0,00	13,6335	46,16
Benidorm	1	100,00	0,7093	0,00
Castellón Capital	0	0,00	3,4242	44,60
Vall d'Uxó	1	11,11	4,5673	53,77
Vinaroz	0	0,00	5,4327	9,11
Valencia Capital	1	100,00	0,0666	0,00
Cárcer	0	0,00	5,7975	40,39
Catarroja	0	0,00	2,7507	84,76
Gandía	0	0,00	4,7658	14,82
Puzol	0	0,00	5,0615	65,80
Requena	0	0,00	3,9276	48,67
Σ	5 ^b	4,00	5,1613 ^c	84,20

^a Variation Coefficient. ^b Total. ^c Arithmetic Avg.

Table 9 – Ranking according to % of efficient municipalities and score.

Collection Zone	Position en in the Model Nr...									
	1 (Basic) ^a		1 (Red.) ^b		2 ^c		3 ^d		4 ^e	
	Scor.	%	Scor.	%	Scor.	%	Scor.	%	Scor.	%
Alicante Capital	2	1	4	9	2	4	3	6	3	5
Alcoy	9	8	3	3	13	4	9	6	10	5
Denia	6	11	14	9	15	4	14	6	15	5
Elche	5	5	6	9	4	4	7	6	6	5
Monovar	4	4	5	4	3	2	8	3	4	3
Torreveija	12	10	16	9	16	3	11	4	16	5
Benidorm	1	1	2	1	11	4	2	1	2	1
Castellón Capital	11	12	10	9	5	4	5	6	7	5
Vall d'Uxó	15	14	15	9	12	4	16	6	9	4
Vinaroz	14	16	11	9	14	4	4	6	13	5
Valencia Capital	3	1	1	1	1	1	1	1	1	1
Cárcer	13	13	13	7	9	4	12	6	14	5
Catarroja	7	7	7	8	6	4	10	6	5	5
Gandía	16	15	12	9	10	4	13	6	11	5
Puzol	10	9	8	6	8	4	6	5	12	5
Requena	8	6	9	5	7	4	15	6	8	5

^a “All Sectors (Basic)”. ^b “All Sectors (Reduced)”.

^c “Performing Arts Sector”. ^d “Musical Sector”. ^e “Audio-visual Sector”.

We can see an excessively low average efficiency ratio in the “Performing Arts Sector” even though homogeneity is also low (a coefficient of variation of 88%). The only zone considered to be efficient is Valencia. Benidorm is not efficient in this sector (an explanation of this result could be the tourism affecting the cultural dynamics of the zone, the authors' rights collection for this sector would be affected by a greater effort in collecting musical and audio-visual rights). The zone of Alicante presents one of the few scores which can be improved in the short to medium-term (1,56). At a municipal level, the number of efficient municipalities diminishes to only 5.

In “Musical Sector”, the situation is similar to that of performing arts, with an average efficiency ratio of approximately 11 but presenting a lesser degree of heterogeneity. Valencia and Benidorm are the only two efficient. Here we have a repetition of the fact that both zones are in fact very efficient (Valencia presents a value of almost zero which implies its being considered efficient independently of its collection while Benidorm would continue to be classified as efficient in the musical sector even though the authors' rights collection is reduced by 72%). The rest are very inefficient. At a municipal level, six of them are efficient, while only two are noteworthy: Valencia and Benidorm.

These last results above are similar to those obtained for the “Audio-visual Sector”, even though the average levels of efficiency tend to improve for this sector; this may be related to a closer approximation to the concept of “cultural industry”, a question that may be materialised in greater control and a more systematic approach to the authors' rights collection. Nevertheless, the greater heterogeneity (in relation to “Music Sector”) confirms for us once again the dichotomy that exists between large/medium-sized municipalities and small ones.

At the end, we can report that the SGAE-Valencia has an average performance that approximates efficiency as is demonstrated by the basic model; from the reduced model we strongly point out the need for drastic measures in zones such as Denia or Vall d'Uxó, where the degree of inefficiency is quite high and bordering on implausibility; more detailed analysis and information is needed in order to follow up the situations in these zones. In a more favourable situation are zones such as Alicante, Alcoy, or Monovar, where the scores produced reflect a strong possibility of improvement in the medium term.

As an indicator of the degree of necessary action for each zone we can refer to Table 9 in which we can choose a sector and ascertain the efficiency of collection or establish a starting point for increasing municipal or zone efficiency.

It must be said that our analysis brought up results that could have been expected; e.g. that the efficient zones correspond to big urban and economic areas. We can infer hence that there are major economies of agglomeration in the authors' rights collection.

In spite of the fact that the calculated frontier in the complete models (“All Sectors”) is not comparable with the sectorial models, we can establish relationships between the efficiency scores. In this way we can show how the total efficiency of collection is greater than the partial efficiencies in each of the sectors concerned; this can reflect to some extent the existence of scope economies in the collection (i.e. the collection network established to collect performing arts authors' rights has an advantageous effect on the efficiency of authors' rights collection for musical events).

We cannot wind up this analysis without pointing out the problems of the technique. Apart from being deterministic (a problem already mentioned in the second section), it is very

sensitive to possible *outliers*. Furthermore, there is the possibility that a particular municipality may be defined efficient by default, i.e. either because there is a lack of a sufficiently extensive reference set in order to carry out the comparison with the necessary power of discrimination or because that reference set simply does not exist (a specialised municipality).

With respect to the first problem, the checking of the database quality and its revision may have led to a reduction, while a measure of the reduction in relation to the second problem may result in 56% of the efficient zones reducing to 13%.

5. Conclusion and Final Comments

Frontier techniques have been extensively employed by economic science in order to quantify productive potential. DEA represents one of the techniques that embraces frontier analysis and it has been widely employed in the evaluation of the efficiency of health care agencies, educative centres (the original application of the methodology), private enterprises (mainly banks) and also public agencies, but only on counted occasions has the world of culture made use of it (museums, theatres or musical groups). It has been in this vein that we have expected to contribute to the frontier analysis.

The use of a non parametric technique is selected due to the fact of the special layout of the transformation process analysed, thus, to avoid functional form misspecification problems.

The results we obtained show how the Valencian delegation of SGAE presents in average, taking into account the municipalities with over 5000 citizens, a certain degree of efficiency, although we have to consider that there is a certain degree of heterogeneity. The joint use of PCA with MDEA has enabled us to discriminate within this indicator of efficiency; it has highlighted issues such as the existence of economies of agglomeration and scope economies in the authors' rights collection, whilst it has permitted the construction of indicators for action on the collection network so that its efficiency may improve.

We conclude hence that apart from the performance of such major cultural and leisure centres as Valencia and Benidorm, efficiency is greatly lacking while there are other zones, such as Alicante, which are viable in the medium term. Municipalities belonging to zones such as Vall d'Uxó, Càrcer, or Denia, are in urgent need of a an extensive review of their respective collection network; this may involve indeed a structural reform so that efficiency is attained in the medium to long term.

Future approximations in ongoing research should deeply examine the relationships between the position of a zone in terms of its collection ranking, as well as its efficiency scores and factors directly related to the collection process, such as the number of collection zones; furthermore, researchers should not leave aside variables specific to the collection agent herself/himself (age, place of residence, number of employees under her/his charge...), etc.

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